

LiMPETS

Long-term Monitoring Program and
Experiential Training for Students

Student Scientists on our Sanctuary Shores



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Program Mission

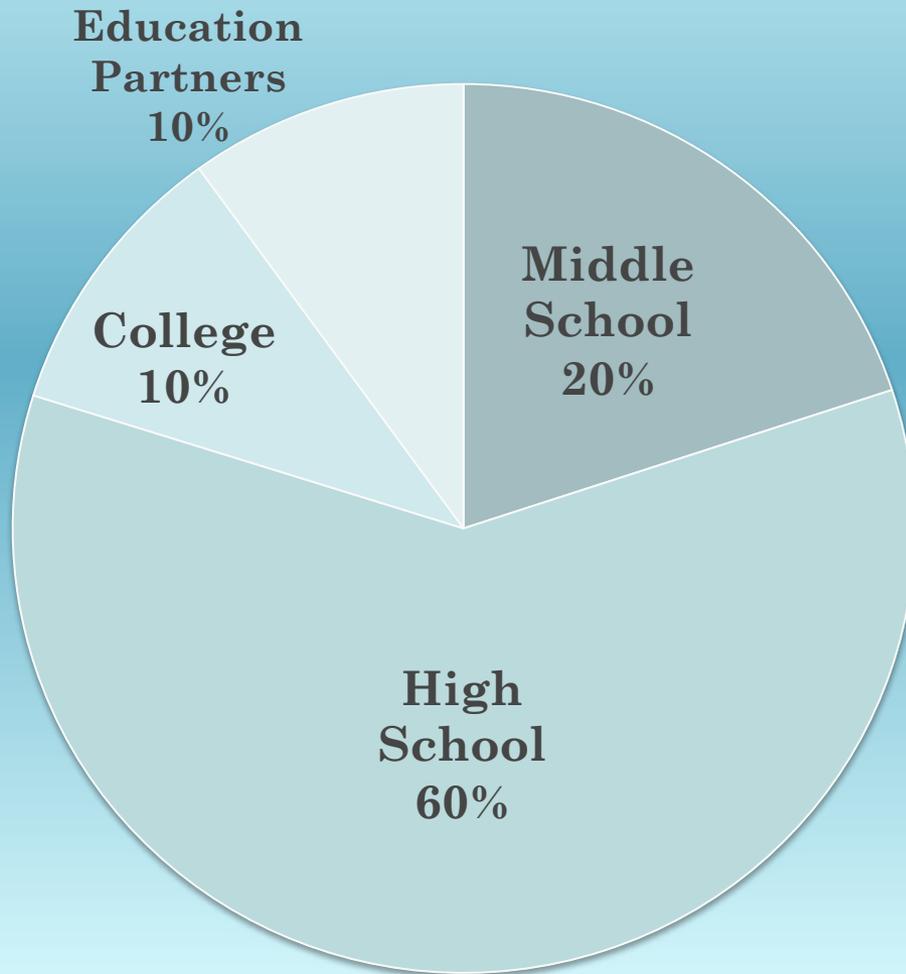
To provide authentic, hands-on classroom and coastal field monitoring experiences that connect teachers, students, and the community to the ocean.

LiMPETS Objectives

- To create a new generation of informed and engaged ocean stewards.
- To develop students' skills and interest in the environmental sciences and motivate some students to pursue a career in the sciences.
- To establish a long-term, baseline dataset that can be used by students, scientists, and resource managers to better assess the health of CA's intertidal.



Our Citizen Scientists



LiMPETS - Program Overview

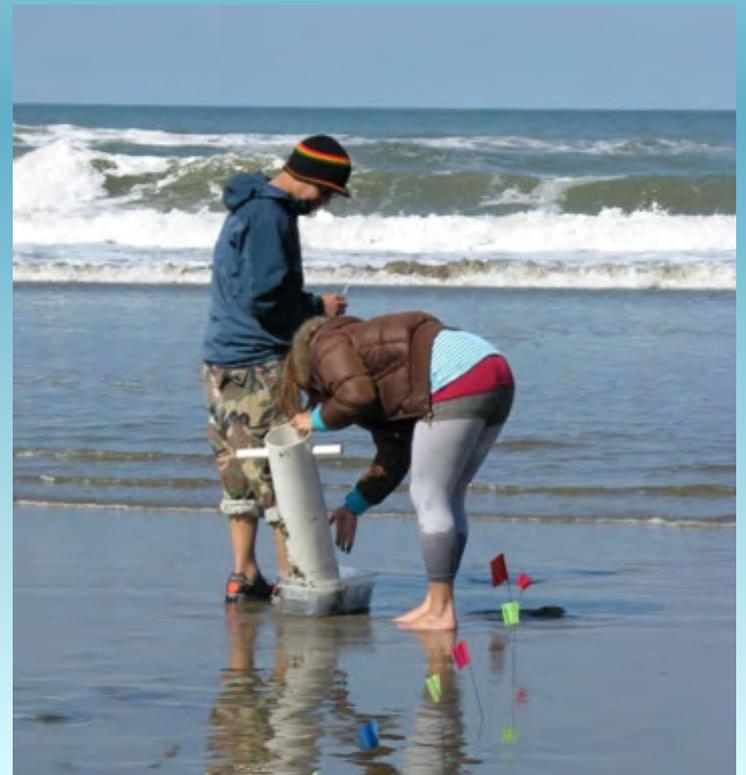
Rocky Intertidal Monitoring

- 30 species of invertebrates and algae
- 4 survey methods: vertical transect, random quadrats, total counts, size measurements of owl limpets.



Sandy Beach Monitoring

- Pacific mole crab
- 5 random transects through swash
- Abundance, size, sex, and distribution



L i M P E T S

Sandy Beach Monitoring Sites

2010



L i M P E T S

Rocky Intertidal Monitoring Sites

2010



Key Elements of Program

1. Teacher Workshop
2. Student In-Class Training
3. Monitoring
4. Data Entry





LIMPETS

Long-term Monitoring Program and
Experiential Training for Students

STUDENT SCIENTISTS ON OUR SANCTUARY SHORES

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LIMPETS is an environmental monitoring and education program for students, educators, and volunteer groups throughout California. Approximately 3,500 teachers and students along the coast of California are collecting rocky intertidal and sandy beach data as part of the LIMPETS network. Join us—learn the process of science and help to protect our local marine ecosystems.



"This was an experience that I will never forget!"

— student, Burlingame High School



LiMPETS Successes

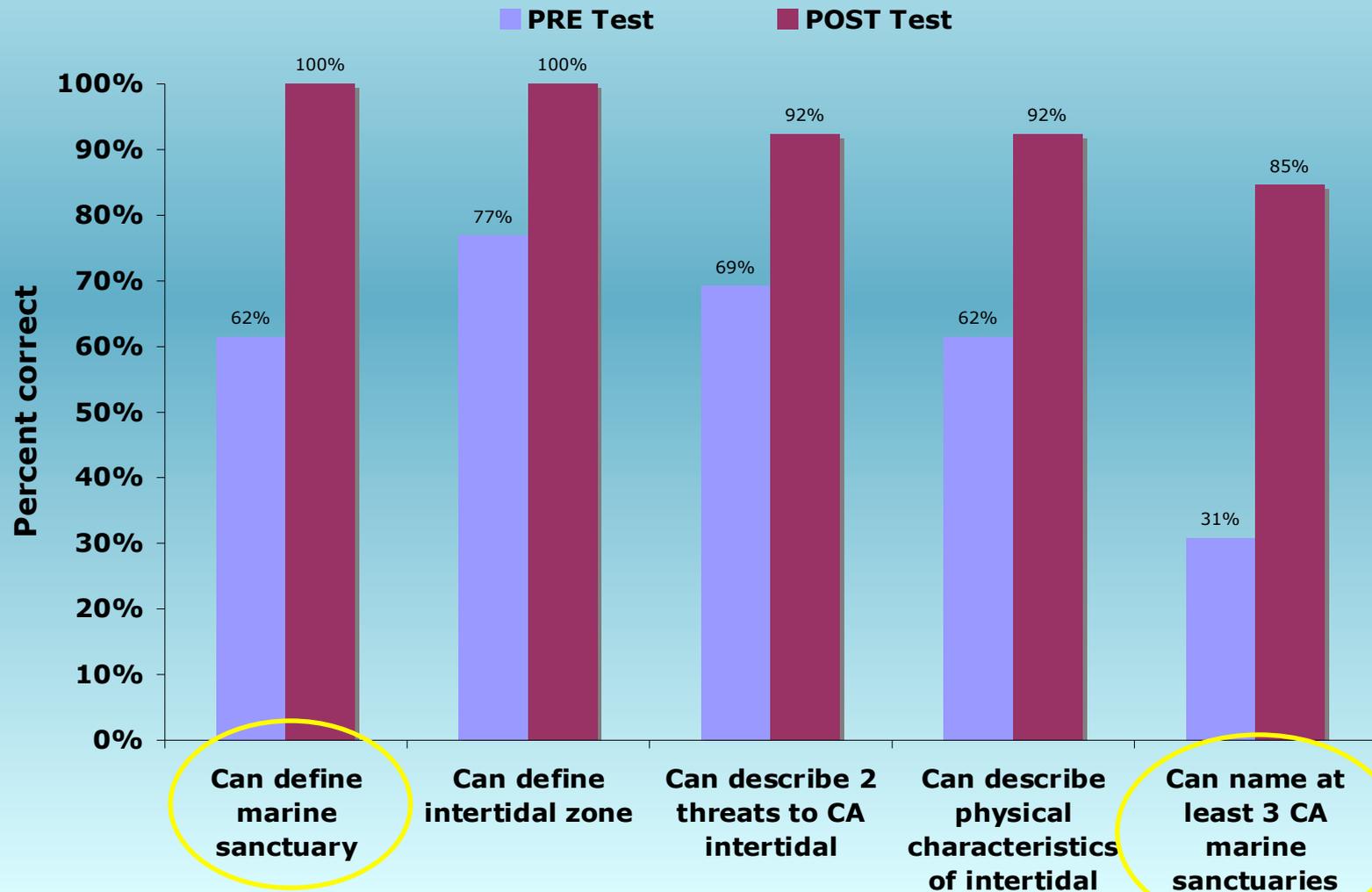
- Ocean Literacy
- Improving Data Quality Control and Data Access
- Informing Marine Management



LiMPETS Successes

Ocean Literacy

Change in teacher knowledge, 06-07 (N=30)



Science Literacy is #1 Reason Teachers Participate (2007-2010; N=58)

1. Authentic Scientific Investigation & Science Literacy
2. Hands-on OUTDOOR learning; connects students with local ocean habitat.
3. Increased awareness of ocean issues and human impacts.
4. Students get a sense for a career in the sciences.
5. Easy to Participate



LiMPETS Successes

Data Quality Control & Access

LiMPETS Long-term Monitoring Program and Experiential Training for Students
STUDENT SCIENTISTS ON OUR SANCTUARY SHORES

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WHAT IS LiMPETS?

ROCKY INTERTIDAL MONITORING

SANDY BEACH MONITORING

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LOGOUT

You are here: Home » Data Entry & Results » Data Entry Step 1: Sandy Beach Monitoring Event » Data Entry Step 2: Select Datasheet » Data Entry Step 3: Sand Crab Datasheet

1. Monitoring Event → 2. Datasheet → 3. Data Entry → 4. Review and Confirm

New Sand Crab Datasheet

Sand Crab Datasheet

Transect number 1

Name of person entering data

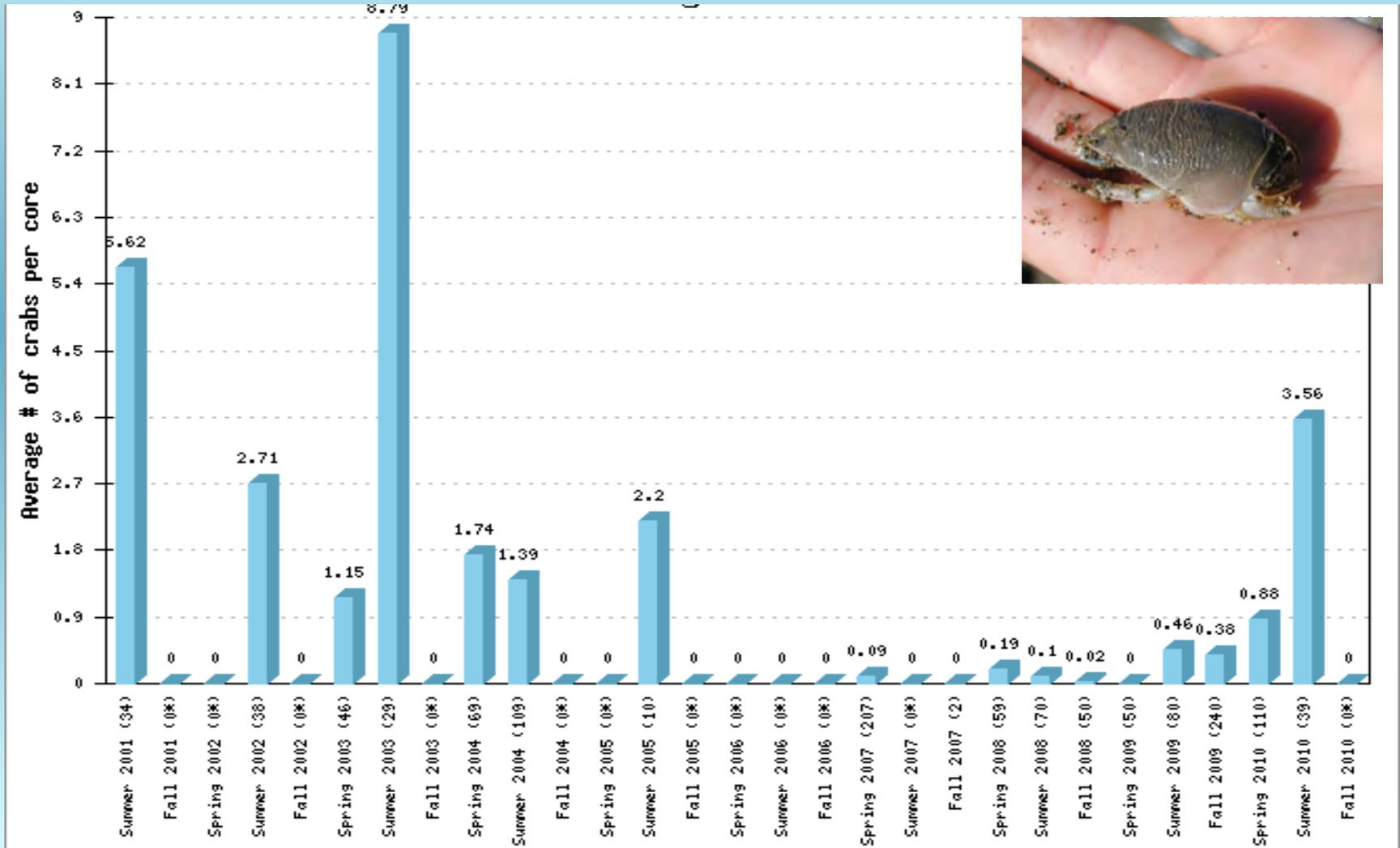
Sample #1

Check this box if zero crabs were found in sample

Crab gender	Crab size (mm)	Tally	Delete
<input type="text"/>	<input type="text"/>	<input type="text"/>	×
<input type="text"/>	<input type="text"/>	<input type="text"/>	×
<input type="text"/>	<input type="text"/>	<input type="text"/>	×
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New Online Graphing Tools

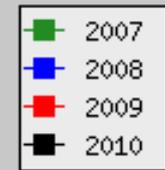
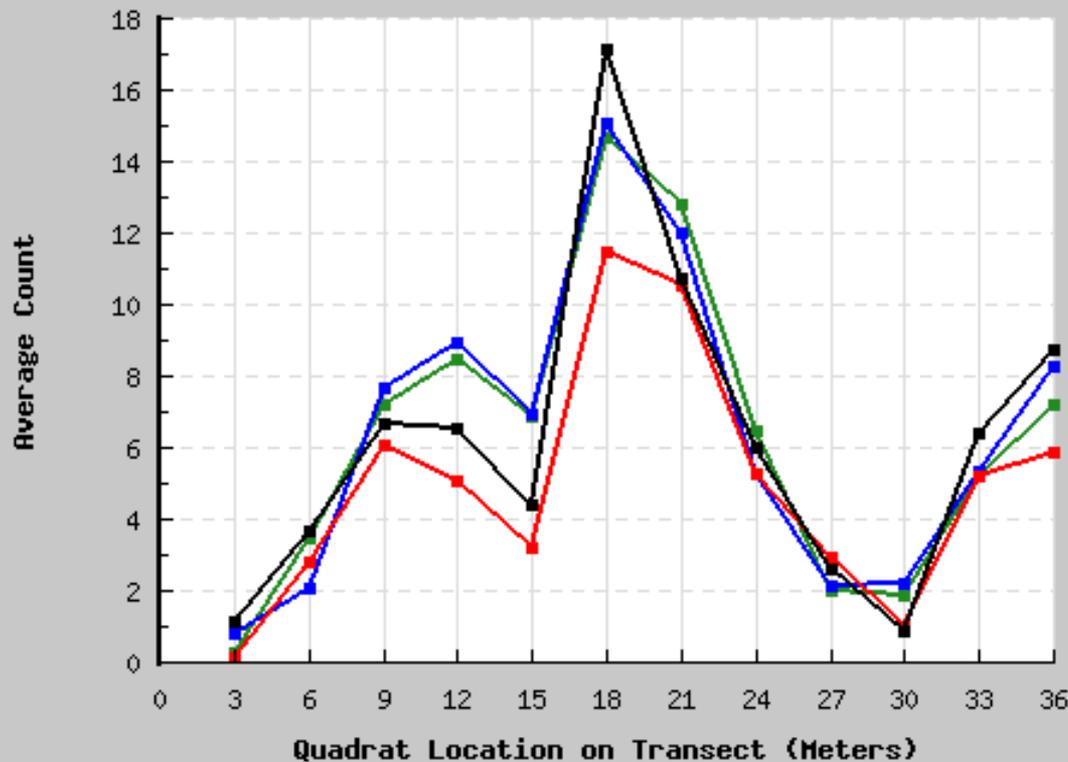
Mole Crab Abundance at Crissy Field Beach: 2001-10

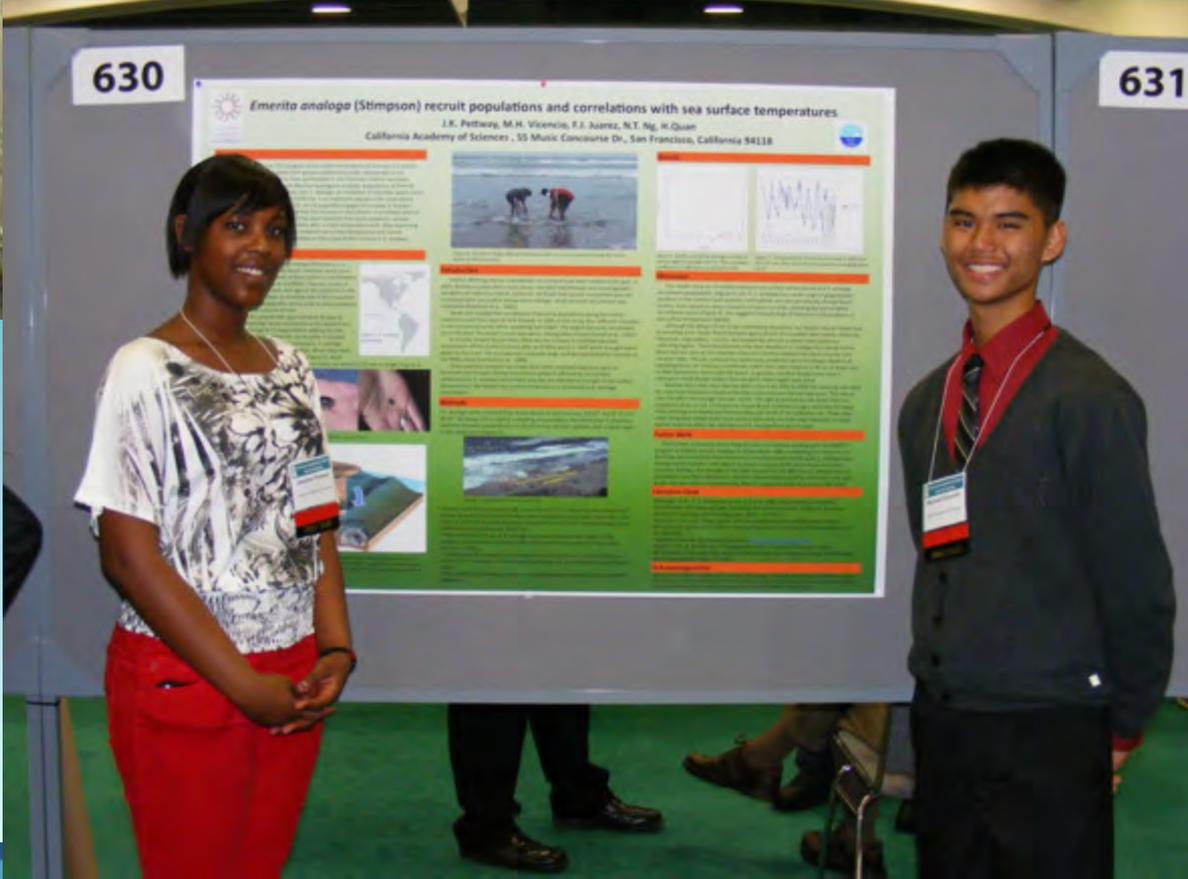
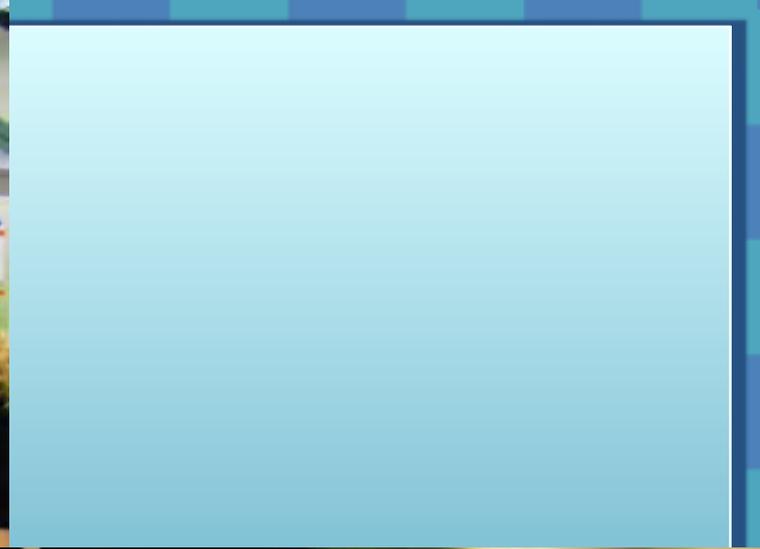


New Online Graphing Tools

Vertical Distribution of Aggregating Anemones: Fitzgerald Marine Reserve 2007-10

Entity: Aggregating anemone - *Anthopleura elegantissima* (< 5cm)
Site: Fitzgerald Marine Reserve
Method: Vertical Transect
Unit: Squares per 1/4m² (max 25)





LiMPETS Successes

Informing Marine Management:

1. Oil spills
2. North-Central Coast MPA Baseline Characterization
3. Annual Sanctuary Reports



LiMPETS Successes

Informing Marine Management:

Simple protocols can yield reliable data

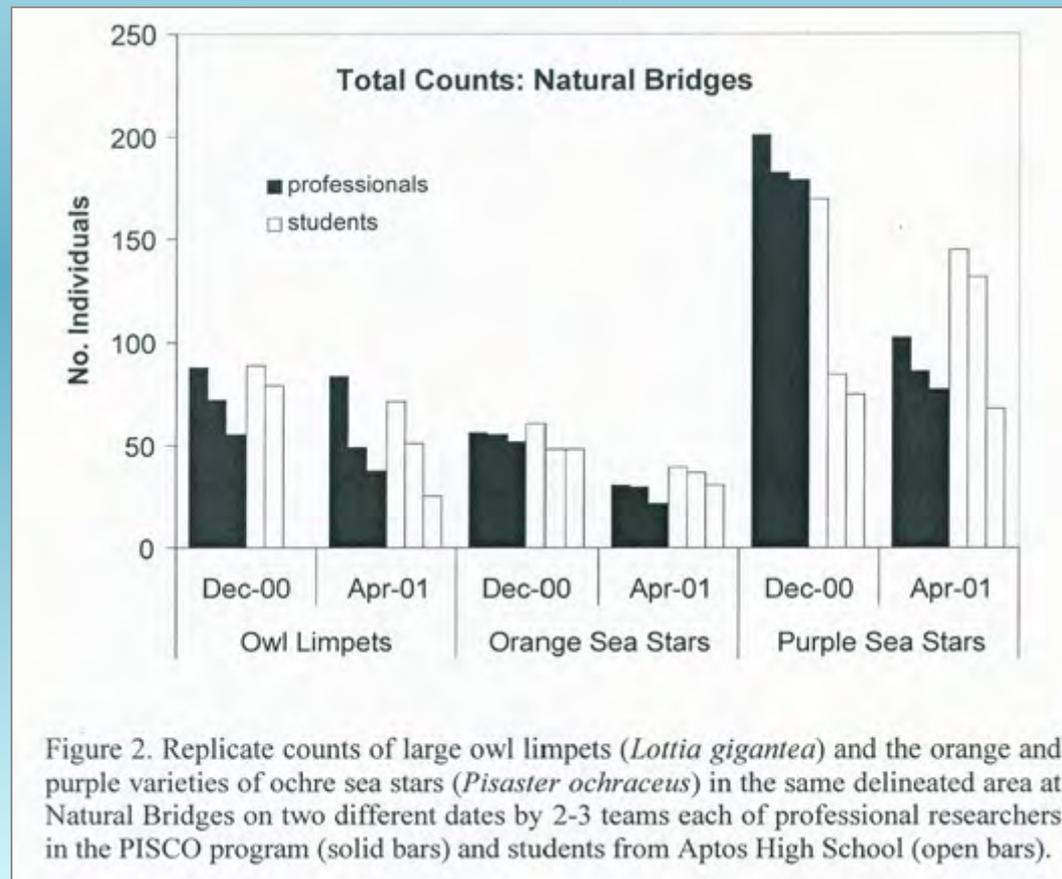
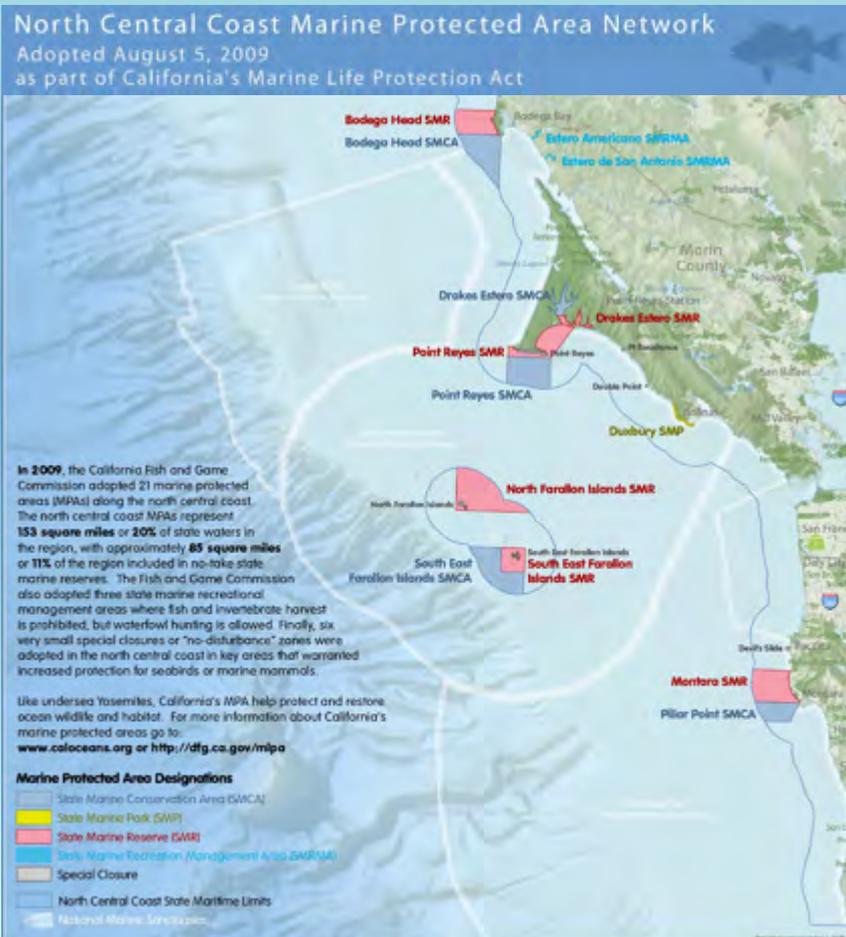


Figure 2. Replicate counts of large owl limpets (*Lottia gigantea*) and the orange and purple varieties of ochre sea stars (*Pisaster ochraceus*) in the same delineated area at Natural Bridges on two different dates by 2-3 teams each of professional researchers in the PISCO program (solid bars) and students from Aptos High School (open bars).

Informing Marine Management: LiMPETS and MPAs



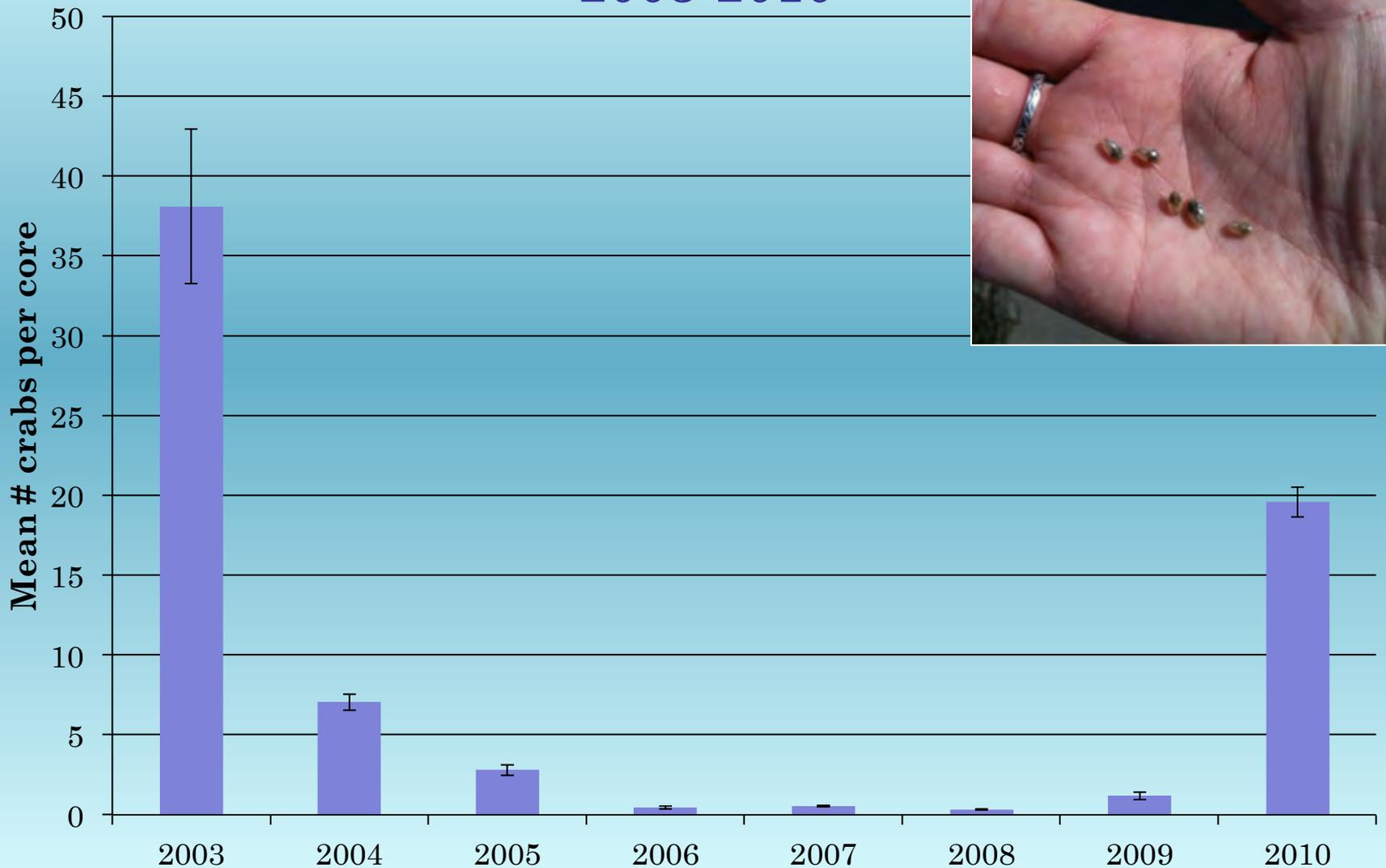
1. LiMPETS awarded 3 yrs of funding to help establish baseline for NCC MPAs.
2. Results will help lay foundation for future assessments of effectiveness of MPAs. Will inform CA whether data is useful & can complement research conducted by scientists.
3. In the process, students and teachers learn about Sanctuaries AND state MPAs.

Informing Marine Management: Sandy Beaches

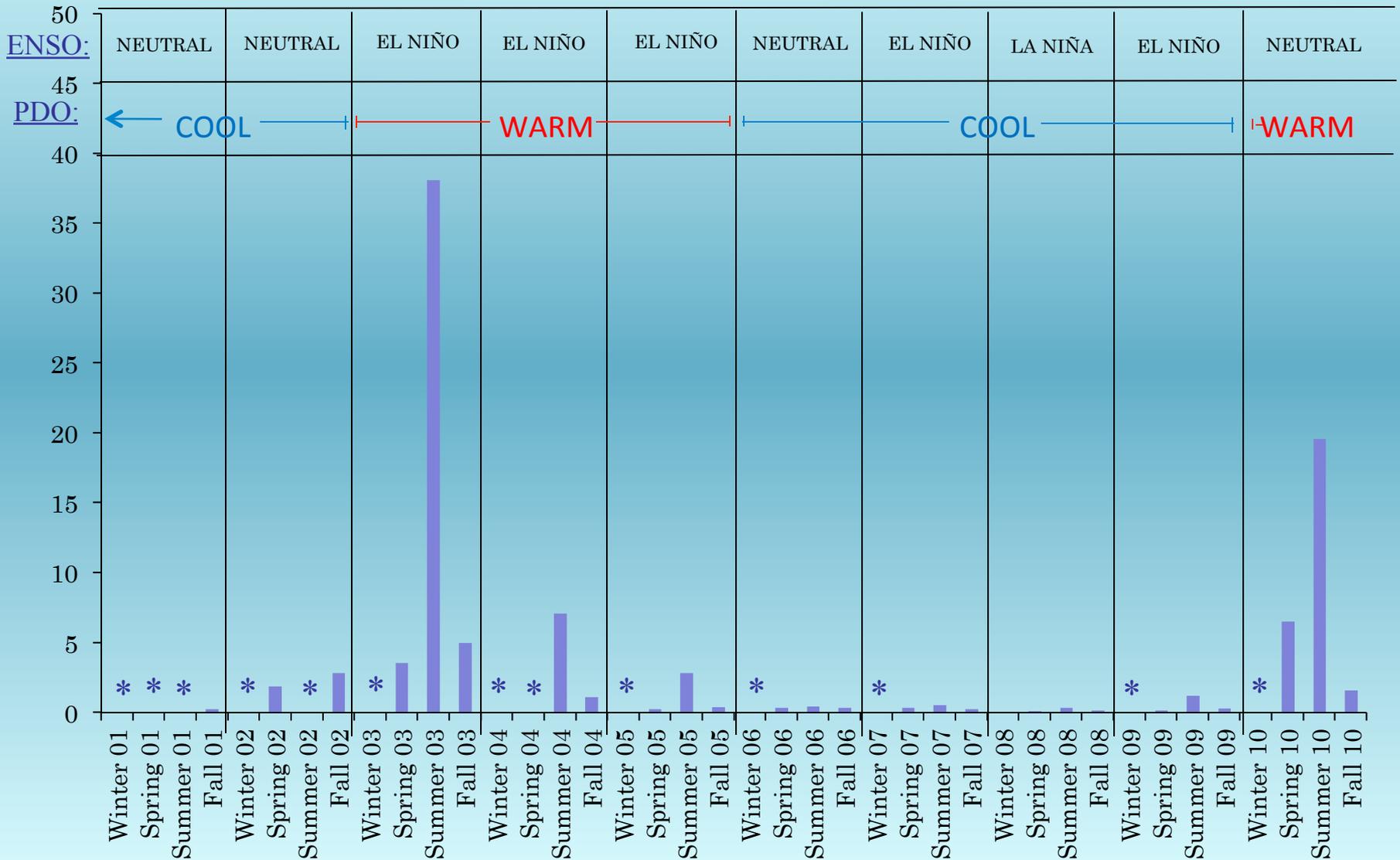
- Mole crabs are vital link in sandy beach food web.
- Mole crabs are focal species for MPA baseline characterization of beaches.
- No long-term dataset exists beyond LiMPETS.



Summer Abundance (\pm SE) of Mole Crabs (*E. analoga*) at Ocean Beach, San Francisco: 2003-2010



ENSO, PDO, and Abundance of Mole Crabs (*E. analoga*) at Ocean Beach, San Francisco: 2001-10



Informing Marine Management: Rocky Intertidal

- Other datasets exist (PISCO and MARINe) beyond LiMPETS.
- Focal species for MPA baseline assessments include:
 - cover of mussels
 - cover of algal species
 - abundance of harvested species



Rocky Intertidal Data:

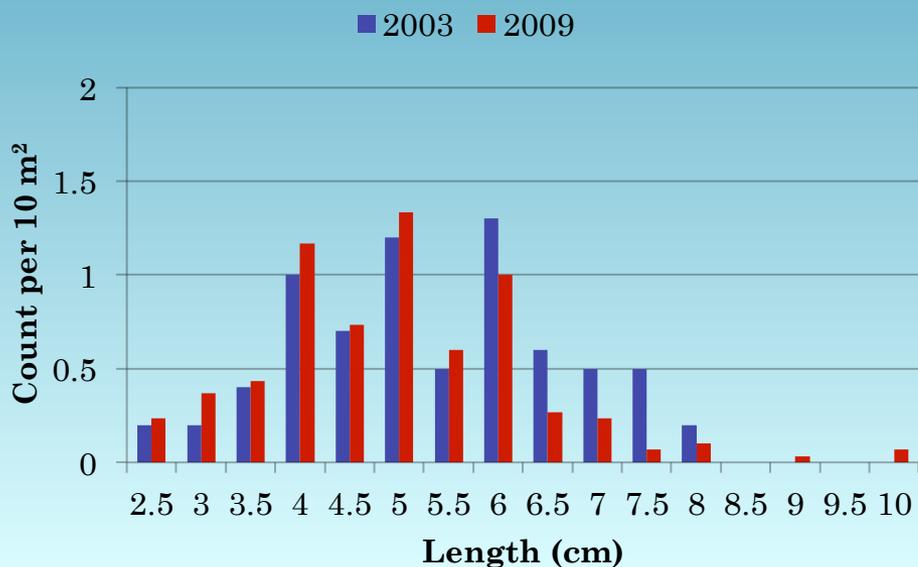
Size Frequency of Owl Limpets at Natural Bridges and Almar Ave, Santa Cruz, CA: 2003 vs. 2009



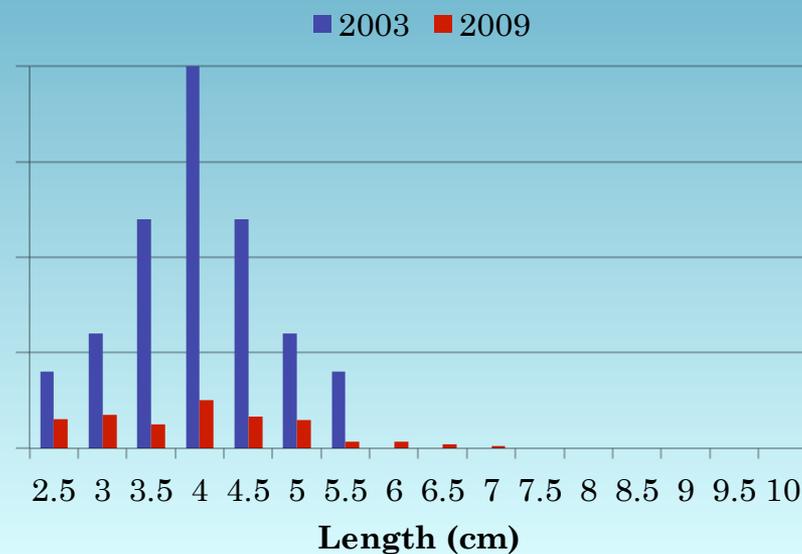
Cruz, CA: 2003 vs. 2009



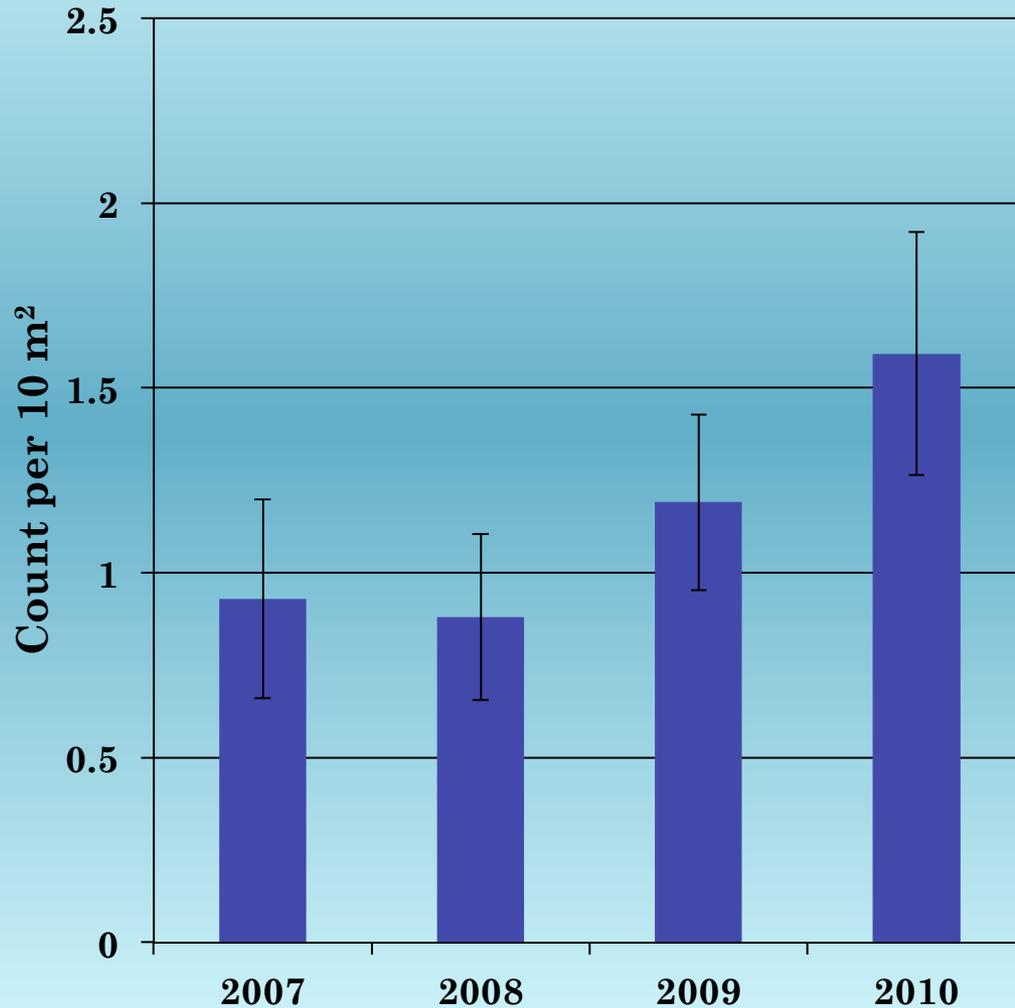
Natural Bridges: MPA



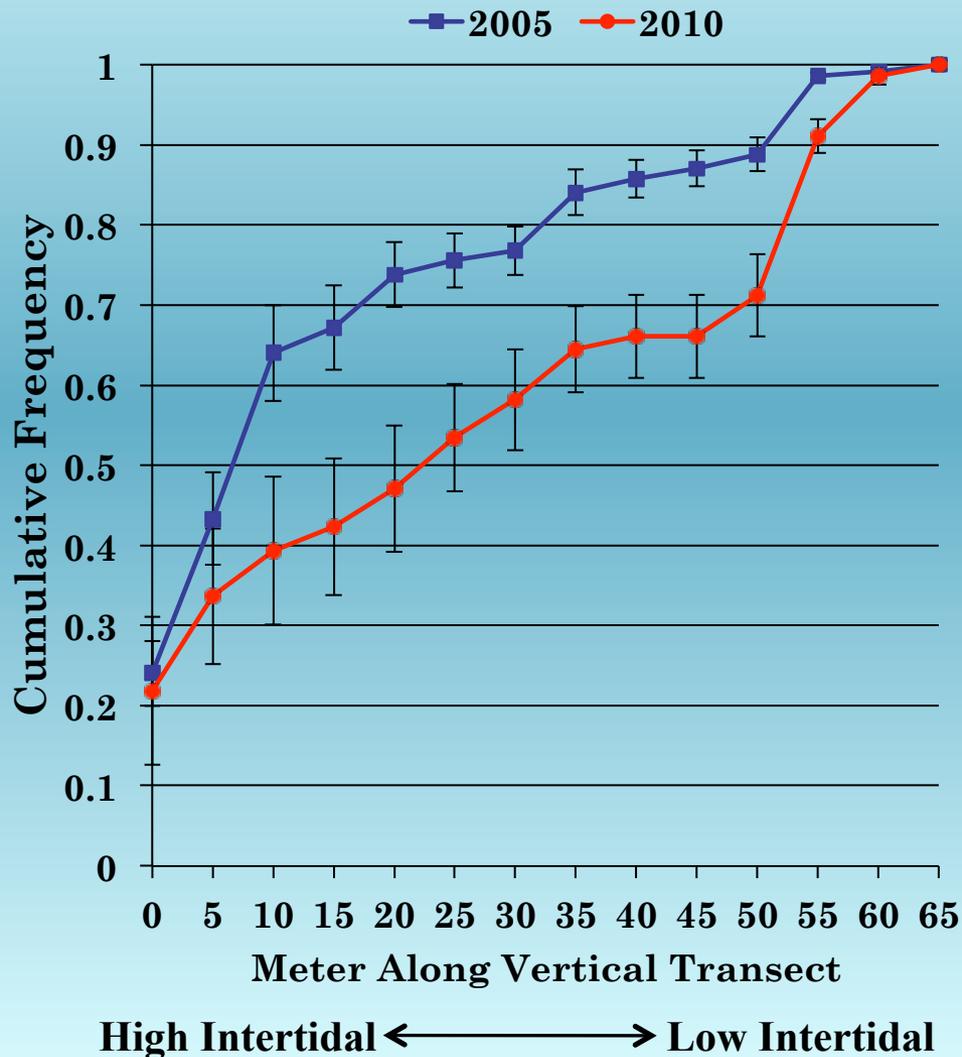
Almar Ave: Non-MPA



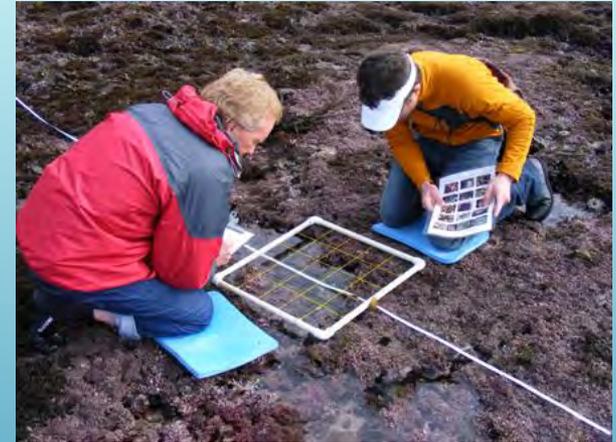
Mean Abundance of Sunburst Anemones (*A. sola*) at Fitzgerald Marine Reserve: 2007- 2010



Cumulative Frequency of Acorn Barnacles (*Balanus/Chthamalus* spp.) Along a Vertical Transect at Duxbury Reef: 2005 vs. 2010



LiMPETS and the Future:



LiMPETS and the Future

ONMS Education Strategic Plan 2010-2020



GOAL 1

DEMONSTRATE EDUCATION MANAGEMENT EXCELLENCE

Outcome: A skilled team of education experts with a strong reputation for developing and delivering high-quality marine education materials and programs that effectively respond to ocean and Great Lakes issues in national marine sanctuaries.



GOAL 2

ENHANCE OCEAN AND CLIMATE LITERACY THROUGH NATIONAL MARINE SANCTUARIES

Outcome: Increased number of ocean- and climate-literate people who are capable of making informed and responsible decisions that may impact the ocean and its resources.



GOAL 3

DEVELOP AND STRENGTHEN STRATEGIC EDUCATION PARTNERSHIPS

Outcome: Increased visibility of the National Marine Sanctuary System and enhanced programming through strategic and effective education partnerships.

LiMPETS and the Future

Five-Year Strategic Plan 2010-2015

GOAL 1

Enhance scientific credibility.

GOAL 2

Identify strategic funding sources.

GOAL 3

Build and maintain core staff.

GOAL 4

Cultivate strategic and effective partnerships.

GOAL 5

Augment education content and standardize implementation of LiMPETS.

National Marine Sanctuaries
National Oceanic and Atmospheric Administration

EDUCATION AND OUTREACH

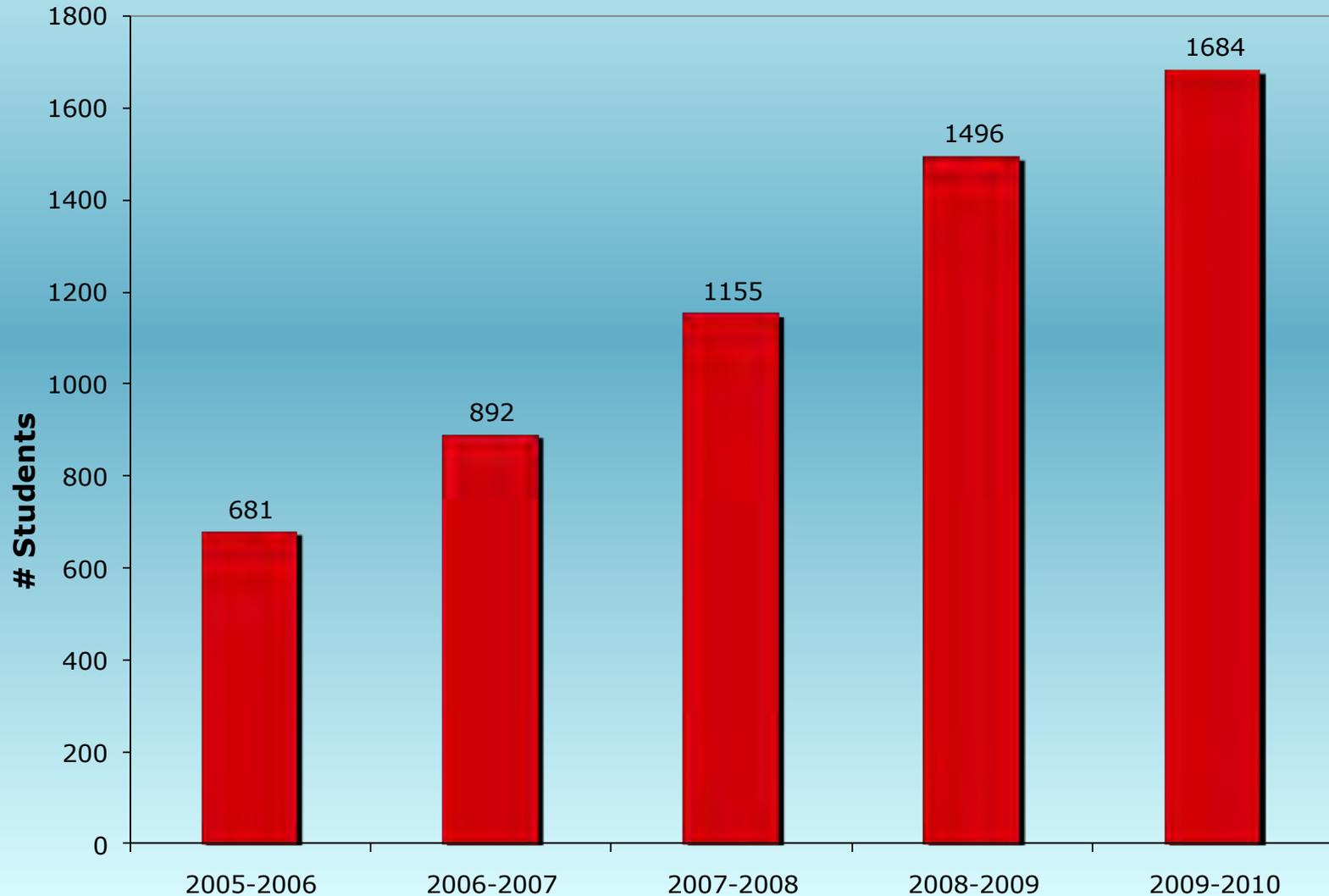
Long-term Monitoring Program and Experiential Training for Students

Teachers conduct LiMPETS monitoring at Frenchy's Cove in the Channel Islands National Marine Sanctuary.

LiMPETS
Five-Year Strategic Plan 2010-2015

LiMPETS and the Future

Number of Student Served Annually: 2005-10



LiMPETS and the Future

The California State Standards and Ocean Literacy Principles

The LiMPETS curriculum is aligned with the following:

- the California Education Standards in science and math for grades 6–12.
- the *Ocean Literacy Principles and Concepts*, which identifies the content knowledge that an ocean literate person should know by the end of 12th grade, www.oceanliteracy.org. Each Ocean Literacy Principle is supported by Fundamental Concepts comparable to those underlying the National Science Education Standards.

The table below outlines the core standards addressed by each activity in Unit Two for grades 6 – 12.

Activity	CA State Science and Math Standards	Ocean Literacy Principles
The Essentials of LiMPETS In-Class Preparation	Grade 6 Earth Science: 2.c. Students will learn that beaches are dynamic systems in which the sand is moved along the coast by the action of waves.	2.d. Sand is redistributed by waves and coastal currents seasonally.
	Grades 6 – 12: Investigation and Experimentation Students will learn about tools and methods used to monitor the sandy beach and will understand why long-term cumulative data is important.	5.h. Tides and waves cause zonation patterns along the shore.
Monitoring Mole Crabs in the Classroom	Grade 6: Investigation and Experimentation 9.b. Students will evaluate the accuracy of their measurements.	
	Grades 6 – 12: Investigation and Experimentation Students will use tools to practice monitoring the sandy beach and will understand why long-term cumulative data is important.	
Investigating the "Crab" in Mole Crabs	Grade 7: Structure and function in living systems 5.a. Students will understand that the anatomy of mole crabs illustrates the complementary nature of structure and function.	5.d. Ocean biology provides unique examples of life cycles & adaptations.
Sandy Beach Food Chain, Trophic Levels, and Biomagnification Game	Grade 6: Math - Number sense 1.0. Students will compare and order fractions or decimals. Students will solve problems involving fractions.	6.a. The ocean affects every human life. It.....affects human health.
	Grade 6: Ecology 5.a.b.c.e. Organisms in sandy beach ecosystems exchange energy and nutrients among themselves and with the environment.	

Unit 2 | Engage and Prepare: In-class Introductory Activities for Sandy Beach Monitoring

Using this curriculum

CA State Standards and Ocean Literacy Principles

ACTIVITY: The Essentials of LiMPETS In-class Preparation

Student Crossword Puzzle.....
 Crossword Answer Key.....
 Sandy Beach Fact Sheet.....
 Mole Crab Fact Sheet.....
 Field Sampling Techniques Fact Sheet.....

ACTIVITY: Monitoring Mole Crabs in the Classroom

Mole Crab Cards.....

ACTIVITY: Investigating the "Crab" in Mole Crabs

Mole Crab Coloring Page.....

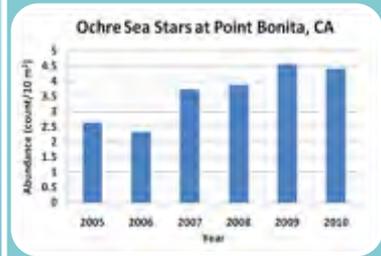
ACTIVITY: Sandy Beach Food Chain, Trophic Levels, and Biomagnification Game

Playing cards.....

ASSESSMENT: Student Reflection

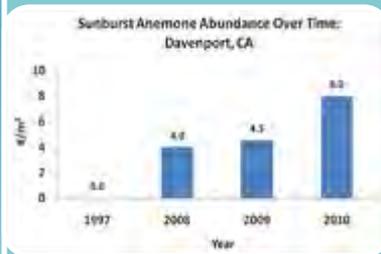
Data Analysis Unit

Graphing 101: Tracking a keystone species over time



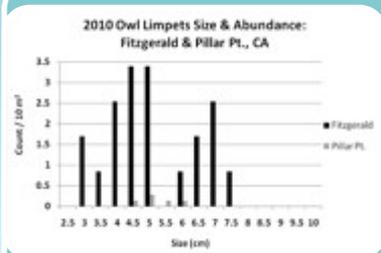
- Students will be able to read and interpret graphs
- Students will understand why long-term monitoring of intertidal species is important

Global Climate Change Exploration: Impact on Intertidal Species



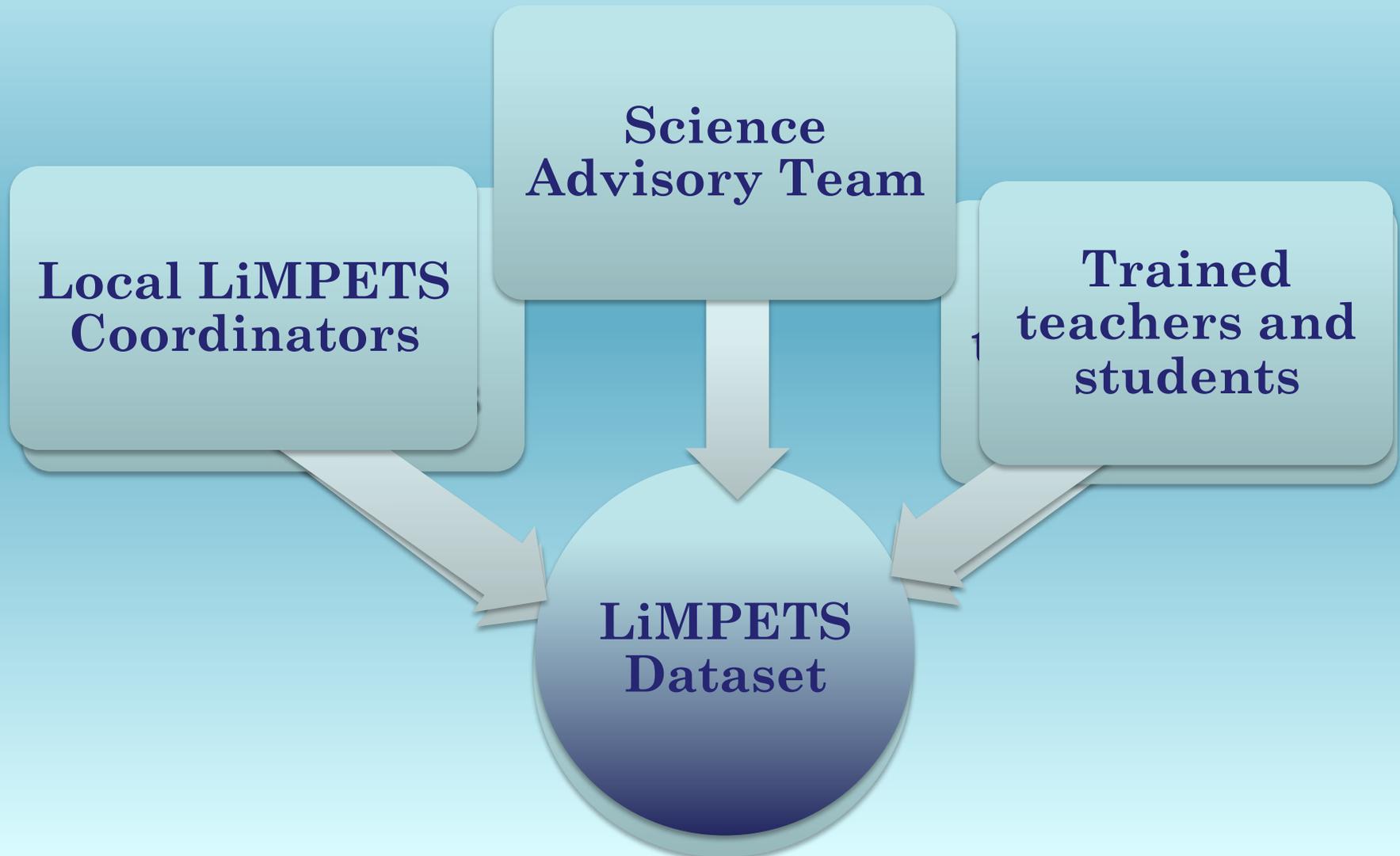
- Students will be introduced to the potential impacts of global climate change on intertidal species.
- Students will use critical thinking skills to determine how the range of a warm water species may be affected by global climate change

Exploring MPAs: Do They Matter?

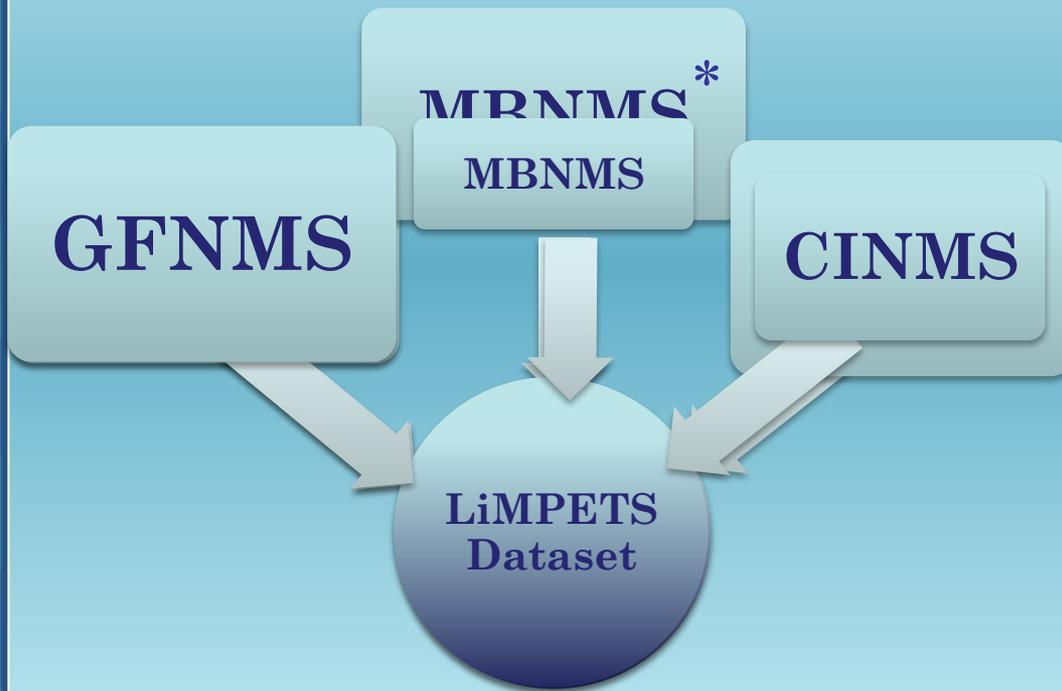


- Students will be able to define MPAs and explain their importance.
- Students will use critical thinking skills to determine if applying protections to areas affects species abundance and size.

The Future: Increasing monitoring effectiveness and data robustness by establishing a *Scientific Advisory Team*.



The Future: Creating a more balanced effort from all three participating sanctuaries



*Hiring of local coordinator at Pacific Grove Museum of Natural History



Funding of LiMPETS:

Lack of adequate funds leads to creative solutions

- Fundraised money (FMMSA, PGMNH)
- Sanctuary budget
 - Staff time
 - In-kind support
- Future: both sides have needs to keep the partnership effective and strong.



The Future: OCNMS and LiMPETS?

- Reviewing current methods, protocols, and species with their coastal habitats.
- Piloting program with 4 schools, starting with rocky intertidal monitoring.
- Evaluate and decide from there.



Conclusions

LiMPETS is unique:

- a student-based citizen science program
- collects long-term data for California's national marine sanctuaries

LiMPETS has already been successful:

- increasing ocean literacy
- currently informs marine management

LiMPETS has big plans for the future:

- a premier ocean education program
- increasing robustness and use of our dataset



How to get involved in LiMPETS

www.limpetsmonitoring.org

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STUDENT SCIENTISTS ON OUR SANCTUARY SHORES

SITE MAP

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"This was an experience that I will never forget!"

— student, Burlingame High School

LIMPETS program througho students rocky inte LIMPETS and help



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SITE MAP

GET INVOLVED SITES SPECIES MONITORED METHODS EQUIPMENT DATASHEETS & FORMS

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You are here: [Home](#) > [Rocky Intertidal Monitoring](#) > [Get Involved](#)

Get Involved

Who can participate?

We work with many different types of school groups, informal environmental education and community organizations. The majority of our participants are high school teachers and students.

What is involved?

- Training:** Teachers or group leaders complete a training by the local LiMPETS coordinator.
- Preparation:** Everyone should learn to correctly identify algae and invertebrates and practice the monitoring methods used in the field.
- Monitoring:** We recommend that you explore your monitoring site and practice the monitoring techniques at least once before monitoring begins. How frequently should you monitor? That's up to you. Some participants monitor only once per year. Others monitor monthly.
- Data Entry:** After data is collected, enter your data online.
- Analysis:** Develop research questions and use the online graphing tools to analyze results.
- Communication:** Sharing your results is important too! Some participants attend scientific meetings, others create informational kiosks or lead community tidepool walks.



Support

We provide direct support and a variety of resources to communities within a 50-mile radius of a National Marine Sanctuary office. Offices are located in San Francisco, Monterey, and Santa Barbara. Services include equipment loan, assistance in the classroom and the field, support with data entry and analysis, and more! Interested in participating in LiMPETS but located outside of our support region? [Learn about our remote LiMPETS programs](#) (pdf 120KB).

How do I get started?

- [Contact the LiMPETS coordinator](#) in your area.
- Learn the protocols! Your LiMPETS coordinator will ask you to complete a training before starting a LiMPETS program at your school or organization. Find out more about LiMPETS [Introductory Workshops](#) in your area.
- Choose an established [monitoring site](#). Your LiMPETS Coordinator can help you.
- Borrow, build or purchase [monitoring equipment](#).



Time commitment



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Questions?

